PHYSICS

MODULE – 1

Physics: Scope and excitement; nature of physical laws; Physics, technology and society.
Need for measurement: Units of measurement; systems of units; SI units, fundamental and derived units. Length, mass and time measurements;
Accuracy and precision of measuring instruments; errors in measurement; significant figures
Dimensions of physical quantities, dimensional analysis and its applications
Frame of reference (inertial and non-inertial frames), Motion in a straight line; Position-time graph, speed and velocity
Uniform and non-uniform motion, average speed and instantaneous velocity, uniformly accelerated motion, velocity-time and position-time graphs, for uniformly accelerated motion (graphical treatment), Elementary concepts of differentiation and integration for describing motion
Scalar and vector quantities: Position and displacement vectors, equality of vectors, multiplication of vectors by a real number; addition and subtraction of vectors, Unit vector, Zero Vector, Resolution of a vector in a plane, Scalar and Vector products of Vectors, Relative velocity
Motion in a plane, Cases of uniform velocity and uniform acceleration, projectile motion, Uniform circular motion

MODULE – 2

Force and inertia, Newton’s first law of motion; momentum and Newton’s second law of motion; impulse; Newton’s third law of motion, Law of conservation of linear momentum and its applications, Problems using free body diagrams
Equilibrium of concurrent forces, Static and Kinetic friction, laws of friction, rolling friction
Dynamics of uniform circular motion, Centripetal force, examples of circular motion (vehicle on level circular road, vehicle on banked road)
Work done by a constant force and a variable force; kinetic and potential energies, work energy theorem, power
Potential energy of a spring, conservation of mechanical energy, conservative and non-conservative forces; Elastic and inelastic collisions in one and two dimensions, motion in a vertical circle
Centre of mass of a two-particle system, Centre of mass of a rigid body, momentum conservation and motion of centre of mass, centre of mass in some symmetric bodies.
Basic concepts of rotational motion; moment of a force, torque, angular momentum, conservation of angular momentum and its applications; moment of inertia, radius of gyration, Values of moments of inertia for simple geometrical objects, parallel and perpendicular axes theorems and their applications to some problems,Equilibrium of rigid bodies, rigid body rotation, equations of rotational motion
MODULE – 3

Kepler’s laws of planetary motion, the universal law of gravitation
Acceleration due to gravity and its variation with altitude, depth and rotation of earth
Gravitational potential energy; gravitational potential, escape speed
Orbital velocity, time period and mechanical energy of an artificial satellite, Geo-stationary satellites
Elastic behavior, Stress-strain relationship, Hooke’s law, Young modulus, bulk modulus, modulus of rigidity, poisons ratio; elastic strain energy
Pressure due to a fluid column; Pascal’s law and its applications (hydraulic lift and hydraulic brakes), Effect of gravity on fluid pressure
Viscosity, Newton’s law of viscous force, co-efficient of viscosity, Stoke’s law, terminal velocity, Reynold’s number, streamline and Turbulent flow, Critical velocity, Bernoulli’s theorem and its applications.
Idea of cohesive and adhesive forces, Surface energy and surface tension, angle of contact, excess Pressure for liquid drop, liquid bubble and air bubble, capillary rise

MODULE – 4

Heat, temperature, thermal expansion; thermal expansion of solids, liquids, and gases, anomalous expansion of water and its effect, specific heat capacity at constant pressure and constant volume and their inter-relation, Calorimetry, change of state – idea of latent heat
Heat transfer- conduction and thermal conductivity, convection and radiation, Qualitative ideas of Black Body Radiation, absorptive and emissive powers, Kirchhoff’s law, Wien’s displacement law, Newton’s law of cooling and Stefan’s law, Green House effect
Thermal equilibrium and definition of temperature (Zeroth law of Thermodynamics), Heat, work and internal energy
First law of thermodynamics, various thermodynamic processes viz. isothermal, adiabatic, isobaric, isochoric processes, work done in thermodynamic process (both isothermal and adiabatic)
Second law of the thermodynamics, Reversible and irreversible processes, Idea of heat engine, Carnot’s engine and its efficiency
Ideal gas laws, equation of state of a perfect gas,
Assumptions of kinetic theory of gases, concept of pressure, r. m. s. speed of gas molecules, Kinetic energy and temperature; degrees of freedom, law of equipartition of energy (statement only) and application to specific heat capacities of gases; concept of mean free path, Avogadro’s number
MODULE – 5

Periodic motion - period, frequency, displacement as a function of time, Periodic functions, Simple harmonic motion (S.H.M.) and its equation; phase; mechanical energy in S.H.M., Simple pendulum - expression for its time period; oscillations of a spring -restoring force and force constant; some other examples of SHM
Free, forced and damped oscillations (quantitative ideas only), simple examples, resonance
Wave motion, Longitudinal and transverse waves, speed of a wave, Expression for displacement of a plane progressive wave, relation between particle and wave velocity, Principle of superposition of waves, reflection of waves, Standing waves in strings and organ pipes, fundamental mode and harmonics, Beats, Doppler effect in sound

MODULE – 6

Frictional electricity, Electric charge and its conservation, Coulomb’s law-forces between two point charges, forces between multiple charges; dielectric constant, superposition principle and continuous charge distribution
Electric field, Electric field due to a point charge, Electric field lines, Electric dipole, Electric field intensity at various positions due to an electric dipole, Torque on an electric dipole in a uniform electric field, Potential energy of an electric dipole
Electric flux, Gauss’s law and its applications to find field due to infinitely long uniformly charged straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell (field inside and outside)
Electric potential, potential difference, Electric potential for a point charge, electric dipole and system of charges; Equipotential surfaces, Electrical potential energy of a system of two point charges in an electrostatic field
Conductors and insulators, free charges and bound charges inside a conductor, Dielectrics and electric polarization, capacitor and capacitance, combination of capacitors in series and in parallel, capacitance of a parallel plate capacitor with and without dielectric medium between the plates, Energy stored in a capacitor, Van de Graff generator

MODULE – 7

Electric current, flow of electric charges in a metallic conductor, drift velocity and mobility, and their relation with electric current; Ohm’s law, electrical resistance, V-I characteristics (linear and non-linear), electrical energy and power, electrical resistivity and conductivity, Carbon resistors, colour code for carbon resistors; series and parallel combinations of resistors; temperature dependence of resistance, Internal resistance of a cell, potential difference and e. m. f. of a cell, combination of cells in series and in parallel, elementary idea of secondary cell.
Kirchhoff’s laws and their applications, Wheatstone bridge, Metre Bridge, Potentiometer-principle and applications to measure potential difference, and for comparing e. m. f. of two cells; measurement of internal resistance of a cell.
Concept of magnetic field, Oersted’s experiment, Biot-Savart’s law and its application to current carrying circular loop.
Ampere’s circuital law and its applications to infinitely long straight wire, straight and toroidal solenoids, Force on a moving charge in uniform magnetic and electric fields, Cyclotron
Force on a current-carrying conductor in a uniform magnetic field. Force between two parallel current-carrying conductors-definition of ampere, Torque experienced by a current loop in a magnetic field; moving coil galvanometer, current sensitivity and voltage sensitivity, conversion of galvanometer to ammeter and voltmeter.

MODULE – 8

Current loop as a magnetic dipole and its magnetic dipole moment, Magnetic dipole moment of a revolving electron
Magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to its axis, Torque on a magnetic dipole (bar magnet) in a uniform magnetic field; bar magnet as an equivalent solenoid, magnetic field lines; Earth’s magnetic field and magnetic elements
Para-, dia-and ferro-magnetic substances, with examples
Electromagnets and factors affecting their strengths, Permanent magnets
Electromagnetic induction; induced e. m. f. and current, Faraday’s law, Lenz’s Law, Eddy currents, self and mutual inductance
Alternating currents, peak and r. m. s. value of alternating current/ voltage; reactance and impedance; LC oscillations (qualitative treatment only), LCR series circuit, resonance; power in AC circuits and power factor, wattles current, AC generator and transformer
Displacement current and its need, electromagnetic waves and their characteristics (qualitative ideas only), transverse nature of electromagnetic waves, electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, x-rays, gamma rays) including elementary facts about their uses.

MODULE – 9

Reflection of light, spherical mirrors, mirror formula
Refraction of light, total internal reflection and its applications, optical fibers, Refraction at spherical surface, lenses, thin lens formula, lens-maker’s formula. Newton’s relation: Displacement method to find position of images (conjugate points) Magnification, power of a lens, combination of thin-lenses in contact, combination of a lens and a mirror, Refraction and dispersion of light through a prism.
Scattering of light - blue colour of the sky and reddish appearance of the sum at sunrise and sunset, Elementary idea of Raman Effect
Optical instruments: Human eye, image formation and accommodation, correction of eye defects (myopia, hypermetropia, presbyopia and astigmatism) using lenses, Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers.
Wave optics: Wave front and Huygen’s principle, reflection and refraction of plane wave at a plane surface using wave fronts. Proof of laws of reflection and refraction using Huygen’s Principle
Interference, Young’s double slit experiment and expression for fringe width, coherent sources
and sustained interference of light.
Diffraction due to a single slit, width of central maximum. Resolving power of microscopes and
astronomical telescopes,
Polarisation, plane polarised light; Malus law, Brewster’s law, uses of plane polarised light and
Polaroids.

MODULE – 10

Photoelectric effect, Hertz and Lenard’s observations; Einstein’s photoelectric equation- particle
nature of light
Matter waves- wave nature of particles, de Broglie relation, Davisson-Germer experiment
Alpha- particle scattering experiments; Rutherford’s model of atom; Bohr model, energy levels,
hydrogen spectrum Composition and size of nucleus, atomic masses, isotopes, isobars; isotones.
Radioactivity- alpha, beta and gamma rays and their properties decay law. Mass-energy relation,
mass defect; binding energy per nucleon and its variation with mass number, nuclear fission and
fusion
Energy bands in solids (qualitative ideas only), conductors, insulators and semiconductors
(intrinsic and extrinsic); semiconductor diode, I-Vcharacteristics in forward and reverse bias,
diode as a rectifier; I-Vcharacteristics of LED, photodiode, solar cell, and Zener diode; Zener
diode as a voltage regulator
Junction transistor, transistor action, characteristics of a transistor; transistor as an amplifier
(common emitter configuration) and oscillator; Logic gates (OR, AND, NOT, NAND and NOR
gates) and their applications
Propagation of electromagnetic waves in the atmosphere; Sky and space wave propagation, Need
for modulation, Amplitude and Frequency Modulation, Bandwidth of signals, Bandwidth of
Transmission medium, Basic Elements of a Communication System